

Application of integrated AHP-TOPSIS method in hybrid natural fiber composites materials selection for automotive parking brake lever component

ABSTRACT

Hybrid natural fiber composites made from the combination of natural fiber and synthetic fiber offers the performance solution while in the same time able to provide further balance between cost and sustainability requirements for automotive structural application. Despite such advantages, the task of designing such hybrid composites during materials selection process such as for matrix materials selection are very challenging considering the involvement of multiple conflicting requirements with varying attributes which are needed to be complied simultaneously by the candidate material. In this paper, multi-criteria decision making technique (MCDM) through the integration of Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method were applied in the materials selection of thermoplastic matrix for hybrid natural fiber composites formulation towards the design of automotive parking brake lever component. Based on literature review, four major types of automotive thermoplastic materials used for passenger car were selected as the materials candidate namely high density polyethylene, low density polyethylene, polypropylene and nylon 6. Moreover, four (4) main design criteria and ten (10) sub-criteria were applied in the selection process based on the product design specifications. The AHP method was first utilized to analyze the weightage of each criteria with respect to the goal and TOPSIS method was later applied to determine the best solution among the thermoplastic material candidates. The overall score shows that polypropylene is the most suitable thermoplastic matrix material for the hybrid natural fiber composites formulation for the intended application. The integrated AHP-TOPSIS method was also found able to provide systematic comparison and selection method to composites designers especially for automotive product development purposes involving hybrid natural fiber composites.

Keyword: Materials selection; Hybrid natural fiber composites; Parking brake lever; AHP; TOPSIS